PCT/AU99/00992

AU 99/992

4

Patent Office
Canberra

I, ANNA MAIJA MADL, ACTING TEAM LEADER EXAMINATION SUPPORT & SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 7013 for a patent by SOLAR ENERGY SYSTEMS PTY LTD filed on 10 November 1998.

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR (b)

WITNESS my hand this
Seventeenth day of December 1999

A. M. Madl.

ANNA MAIJA MADL
ACTING TEAM LEADER
EXAMINATION SUPPORT & SALES

AUSTRALIA
Patents Act 1990

COMPLETE SPECIFICATION
PROVISIONAL PATENT

DOUBLE ACTING "POLY PISTON PUMP"

The invention is described in the following statement:

The nature of the piston pump is that of a positive displacement, forced action and self-priming pump. Bruno Wittwer, the designer of the Poly Piston Pump, heard constant negative feedback on the dominant rotary pump used in solar applications, primarily in the agricultural sector. Solar driven pumps stop at night and start automatically in the morning at daybreak. If the water is lost in the suction pipe overnight, the pump will pump air instead of water, which wears out the pump rapidly in the morning causing pump failures. The criticism was that they were not self-priming, not reliable or of a high quality. They were not able to pump when not running at their specified RPM due to the centrifugal nature of the pump. For that reason, an overcast day will see the pump running at 50% of its specified RPM, hence not pumping any water. Since bore pumps were totally submersed in water, leakages in to the electrical motor of the pump were not uncommon.

Farmers were commonly heard to say, "why can't someone build a pump like the old windmill piston pump", because they are simple and easy to work on. After observing the nature of windmill pumps, he noted that a flywheel effect created by the weight of the ½ inch metal pump rod meant the singular lifting action of the piston pump was suited to windmills but wouldn't be useful for solar panels (double power required for the up-stroke, and no power required (and nothing achieved), on the down-stroke) i.e. Double the power would be required with solar panels.

To combat this, Bruno looked at the constant pumping action of the rotary pump, and the resulting steady power requirements on the solar panels. Bruno realised he needed a double acting pumping mechanism with a piston pump, particularly with a sealed top so pumping could continue above that height.

The resulting pump is a poly piston pump, which uses 50% power on the up-stroke and 50% power on the down-stroke, designed specifically for use with solar panels. The pump operates at full efficiency when the solar panels are exposed to full sunlight, and at a lesser rate on overcast days, where through its forced action the pump still delivers water. Any sunlight to the panel would result in the pump operating, and an amount of water being delivered to the surface, as maximum power is not a pre-requisite.

DOUBLE ACTING POLY PISTON PUMP

The invention relates to the design of a self-priming piston pump, which incorporates the concept of positive displacement of liquids, and utilises a forced action to effect the pumping of a liquid (in particular water) in a vertical or horizontal trajectory. This design uses a double action of the pump (i.e. the up stroke effect of the piston and the down stroke effect of the stuffing box and plastic rod (polystone 7000 rod)) which balances the use of the power generated.

The benefits of this type of pump are fourfold:

1. The transfer pump is self- priming, which is common to all piston pumps, meaning that once power is supplied to the pump-drive the piston will draw water from the source until it passes the piston, at which point it becomes a forced displacement action. Any amount of power supplied will drive the piston and produce water flow.
2. The double action of the bore and transfer pump, which incorporates the common U-shaped seal in the piston lifts the water on the up-stroke, and forces the remaining water in the pipe to rise during the down-stroke through displacement due to the effect of the pump rod pushing back down into the column and the sealing effect of the stuffing box.
3. The up-stroke of the bore pump requires minimal power, as it is assisted by the flotation effect of the hollow piping rod being lifted by the water once it has hit it's lowest point, thus minimising the power required in the upstroke of the rod into the water filled column.
4. The pump body and outlet is built out of ABS thermoplastic, which is UV stabilised, wear resistant and non-corrosive (which is particularly important in areas of hard water or where the water has a high level of salinity).
5. If the U-cup seal on the piston fails the bore pump will still deliver 50% of the water on the down-stroke.
6. In case of water not being available at the source, the pump will not be damaged except for in extended dry circumstances, in which case only the piston seal needing to be replaced.

DESIGN

Bore and Transfer Pump

The poly-piston pump has a number of different components, which need to be described individually.

1) It is constructed from ABS thermo plastic, with its characteristics being that it is UV stabilised, wear resistant and non-corrosive. This presents various advantages. The piping and seals experience minimal wear during pumping even when it is running dry. Salinity or hardness of water has no effect.

2) The stuffing box incorporates the common U-cup seal, which remains under constant pressure during uphill pumping due to backpressure. The piston seal spreads to seal the inside of the outer column on the up-stroke, thus lifting the water, and then becomes streamline to the piston creating no resistant on the down-stroke.

3) A special glue (Tangit glue) is used to fasten all sections of pipe, and components. Trials were done with screw joints and common PVC glue, but it was found that the constant motion produced wear and tear and thus shortened it's effective life, whereas Tangit glue has been used on pipes submersed for over seven years and has shown no sign of weakening, or allowing any leakage or breakage of joins.

4) The pump rod is made from hollow PVC pressure pipe, with solid plug joiners between each length of pipe. This ensures that should one length of pipe in the pump rod leak, only that length will fill with water as opposed to the entire pump rod, enabling the pump to continue operating and making for easier repairs. The plug is internal, meaning the rod joins do not inhibit the flow of water between column and rod. This is an advantage over the use of external couplings.

5) The large diameter of the pipe means only small volumes of water are contained in the space between the piston rod and the outer column. For a 50mm column the piston rod will be 32mm in diameter. Lesser water means lesser weight in the column. As such, only half the power is required on the upstroke.

6) By using a large diameter of pipe as a piston rod, we avoid lifting more water than is displaced on the upstroke.

7) Centralisers keep the column in position within the bore casing. A centraliser consists of three pieces of PVC strip molded into a bow shape. By attaching the centralisers to the pump column and every second length of PVC pipe, they stabilise the column within the bore casing.

8) The column is made from 50 mm PVC pressure pipe gluing directly into the ABS pump body at the bottom and the ABS outlet on the top.

9) As a piston for the 3inch and 4inch pumps a standard return valve is used in combination with a U cup seal and two faucet sockets with four diagonal drill holes. The internal workings of the piston consist of a nipple which screws into the return valve at one end and a faucet socket at the other. This has the effect of holding the seal body in place between the return valve and the faucet socket.
An alternative design centres around the 2" piston design. This consists of a 4" base containing three inlet holes of 28mm diameter, which on an upward stroke are closed by three acrylic balls contained within individual chambers behind each inlet. The outer face of the piston has a U-cup seal positioned within a groove approximately one centimetre from the base of the piston, above which the outer face becomes a smaller diameter. Above the U-cup seal where the piston diameter becomes smaller, lie three outlet holes. On the top of the piston where the piston pipe is glued in place is situated three more holes allowing additional water to flow. The bottom of the piston pipe also has three outlet holes, directly above which is situated a solid PVC plug. The top of the PVC rod also contains a solid PVC plug with an M16 thread as a pickup point for the crank arm of the pump drive.

FUNCTIONALITY

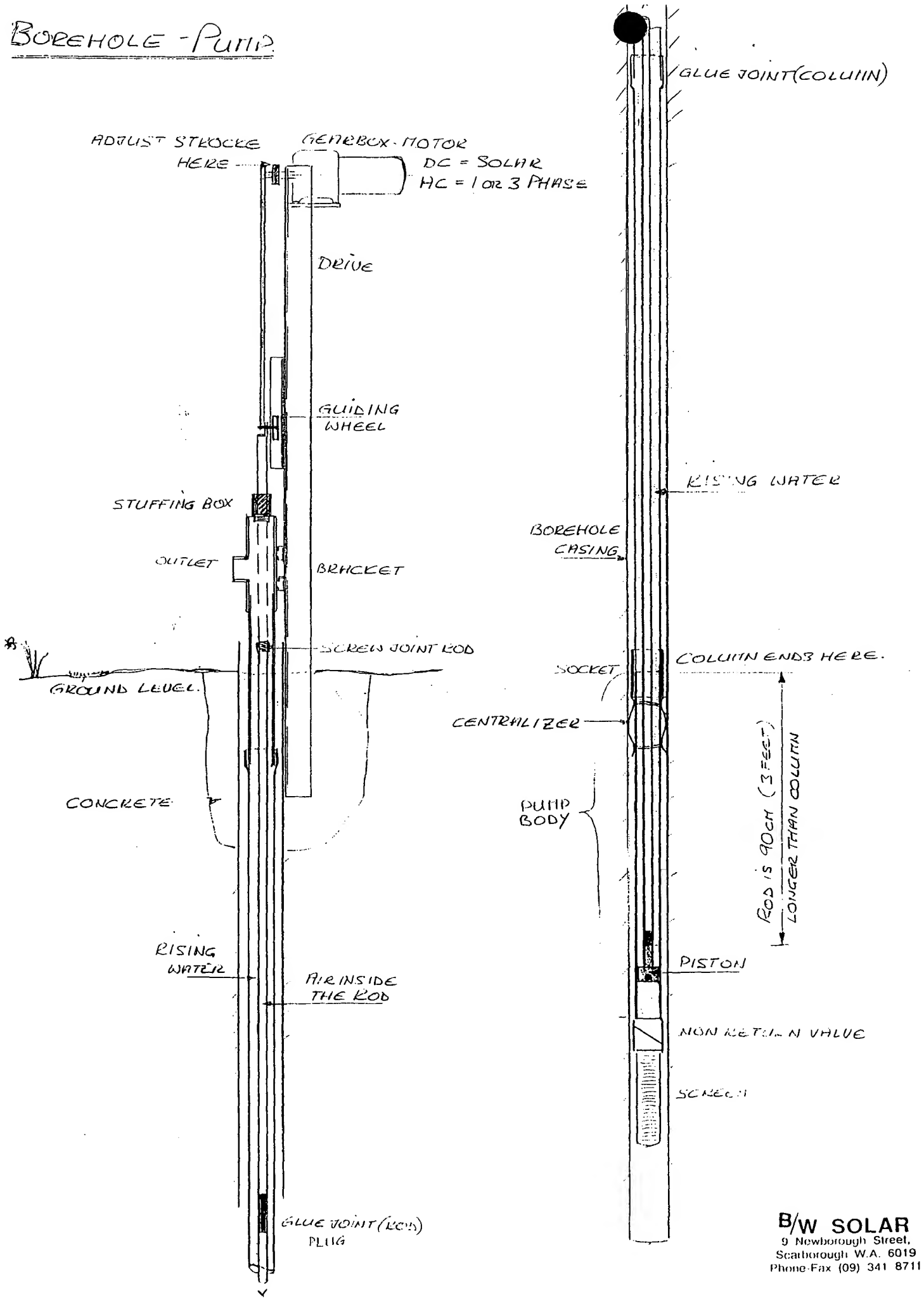
1) The bottom section of the pump has a screen consisting of vertical slits cut into the wall of the PVC pipe, which allows the water to flow into the lower section of the pump.
2) Above the screen is a non-return Philmac foot valve, which allows the water to rise into the next section of pipe, but not filter back into the bottom of the screen or back into the water source. The water moves through the non-return valve when a vacuum is created with the up-stroke of the piston lifting the water currently in the pipe, by the distance of the piston stroke. With each up-stroke of the piston, when the pump is full, an amount of water equivalent to the volume inside the pipe, (less the area consumed by the pumping rod), and to the length of the piston stroke, will be delivered from the outlet at the top (above ground level) of the pump. The water which has entered the space created by the up-stroke, will then be displaced upwards upon the piston and rod moving in a downward motion back to the start position. On the downward stroke, the Polistone 7000 rod entering the pump through the stuffing box displaces the other half of the water pumped. Simultaneously, the water is forced through a hole at the bottom of the piston, and out through three outlet holes situated above the U-cup seal. A 25mm (1 inch) acrylic ball that is in place in the small bottom cavity of the piston then seals that hole on the up-stroke.
3) An added advantage of this design is that the pump rod is hollow and fixed to the end of the piston, meaning air is trapped inside, using less energy whilst lifting the fluid on the upstroke, thus balancing the power used between up and down strokes.

POWER REQUIRED / USAGE

Power is supplied from a number of solar panels, typically two, four or six, that are assembled in a specifically designed frame that is linked to a tracking unit which will ensure the panels are always in position to receive the optimum level of sunlight. These are then used in conjunction with a DC motor. With optimum sunlight the pump will operate at 45RPM's.
The pump can also be manually operated, by wind power, water wheel, electric motors (AC) or combustion power. The pump is capable of being adapted to any power source.

On behalf of Solar Energy Systems Pty Ltd **9th of November 1998**

BOREHOLE - PUMP



B/W SOLAR
9 Newborough Street,
Scarborough W.A. 6019
Phone-Fax (09) 341 8711

B/W SOLAR

Phone / Fax: (08) 9341 8711
Mobile-phone: 0417 931 316

What makes

POLY-Piston-PUMPS™

The SIMPLEST and the BEST ??

B / W SOLAR's POLY-PUMPS *are double acting plastic piston pumps. A simple but cleverly designed piston allows the water to flow through a ball valve and eliminates* ***unwanted friction. (Plastic is resistant to corrosive water.)***

Double acting means that one half of the water is pumped on the upward stroke and the other half on the downward stroke. Therefore, the pumping system is perfectly balanced, ***highly efficient and requires only half the power.***

The top-end (500mm) of the piston-rod is made out of ***non wearing nylon,*** *guided by a stuffing box with a wiper and seal for uphill pumping.*

POLY-PUMPS are available in 2", 3" & 4 inch (50, 80 & 100mm) sizes.
COLUMN and ROD are PVC PRESSURE PIPE and can be purchased locally.

WITH THE POLY-PUMP™:

- **SOLAR DRIVES** require fewer panels ⇒ CHEAPER
- **ELECTRIC MOTORS** use less power ⇒ CHEAPER
- **WINDMILLS** pump with much less wind ⇒ **MORE WATER**
- **WIND TURBINES** can be smaller in size ⇒ CHEAPER
- **WATER WHEELS** can be used as drives ⇒ INEXPENSIVE
- **HAND PUMPING** is possible to considerable depths.

✹ 10 REASONS WHY *YOU* SHOULD BUY A POLY-PUMP ✹

FEATURES	POLY-PUMP	WINDMILL	SUB-PUMPS
1.Simple and easy to install	YES	NO	?
2.Very low maintenance	YES	NO	NO
3.Retractable piston with seal	YES	NO	NO
4.Absolutely non corrodible	YES	NO	NO
5.Wear and UV resistant pump body	YES	NO	NO
6.Very long life (body = 3 x stroke length)	YES	NO	NO
7. Pumping in wind-droughts	YES	NO	?
8.Water pumped when most needed	YES	NO	?
9.Easy to upgrade	YES	NO	NO
10. Several drive options	YES	NO	NO

INSTALLATION PROCEDURE for 50mm BOREHOLE POLY-PUMP™.

Important: Measure the bore's depth first, then pre-assemble the pipes and cut them to the correct length, but do not glue yet. The piston rod must be **90 cm / 3 feet** longer than the column to compensate for the pump's body length.

1.) Use 50-mm PVC pressure pipe (class 12) as column, up to a maximum depth of 36 m / 120 feet. Glue the pipe directly into the socket on the pump. Additional column joints must also be glued. Do not use screw sockets. Lower the pump body with the first pipe (column) into the bore secure the end of the pipe onto the pumps bracket on the drive unit. Now glue and join the second pipe into bell of the first one, and so on. Finally glue the outlet (tee piece) into the bell of the last length of pipe. **Important: No "quarter turn" with this special adhesive.**

2.) Make sure the foot valve and stainless steel rope are fitted properly and the centralisers are spread around the pumps body before lowering it into the borehole.

3.) Use 32-mm PVC pressure pipe (class 18) as piston rod. Maximum depth as above. Glue the piston stem directly into the first length of pipe (rod.) Additional rod joints must also be glued. Insert the piston attached to the first rod into the column and lower it down. Secure the rod's end with a grip tool. Now glue the second rod into the bell of the first one, and so on.
If couplings are required, use "Vinidex" only as they are slim enough to fit inside the column.

IMPORTANT: All joints must be glued airtight. Use thread seal tape on the screw fitting of the rods top joint.

On Windmills, the PVC rod may need to be partly filled with water to increase the weight on the down stroke. (Not all windmills are suitable to *push* down.)

4.) If connected to a windmill, the pump rod and windmill rod must be perfectly aligned. The connecting point must be close to the stuffing box, with about 1" clearance. (Stroke fully down.)

5.) For maximum strength always use cleaner and **tangit** glue only. Leave the glued joints undisturbed for at least 5 minutes; **do not pump for at least 24 hours.**

6.) The average rotation per minute should be 45 rpm. Do not exceed 50 rpm. (Eg. if the pump is driven by a petrol motor.) The pump looses its efficiency at a higher speed.

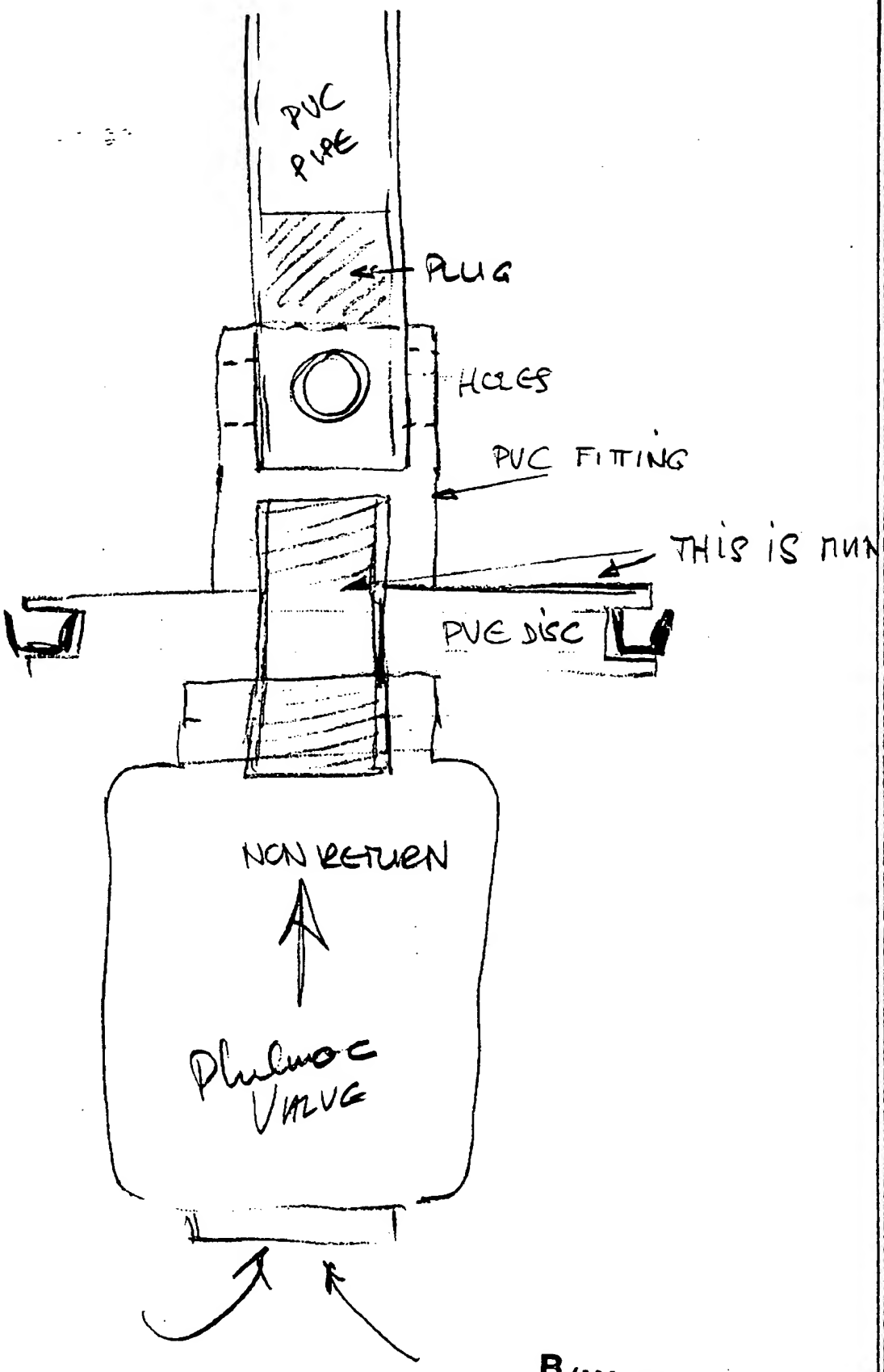
7.) The stuffing box is filled with water-resistant grease to reduce friction. Do not overfill; as to much grease will deform the U cup seal or drag up on the rod and collect dust and dirt.

8.) Back-pressure to the stuffing box is essential for the lubrication and cooling of the piston rod. Never run the pump without water over a long period.

9.) Poly-pumps are only covered by our warranty if all the above instructions are followed and the centralisers are fitted as required. (Every 12 m.)

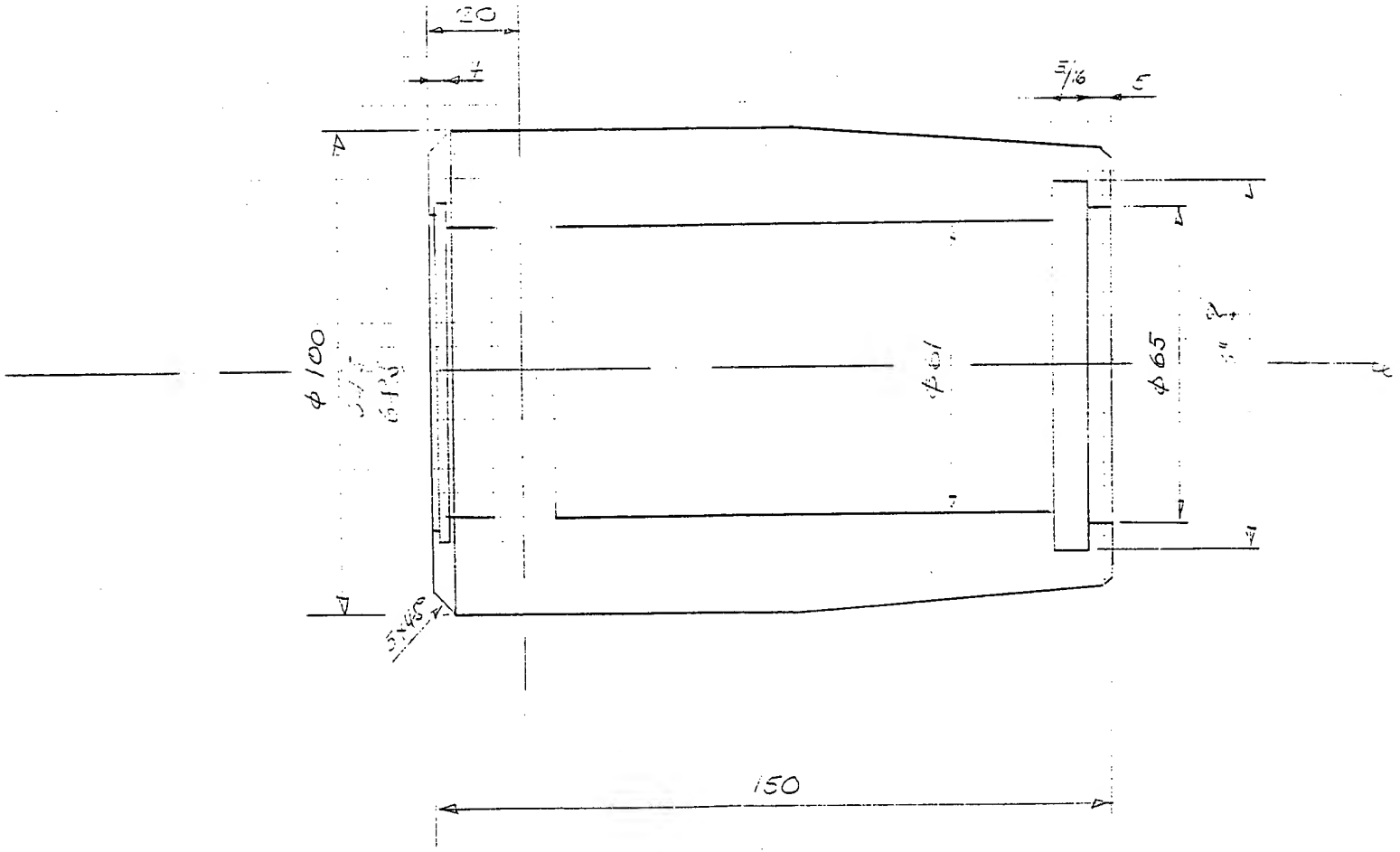
POLY PUMP 3 + 4"

PISTON



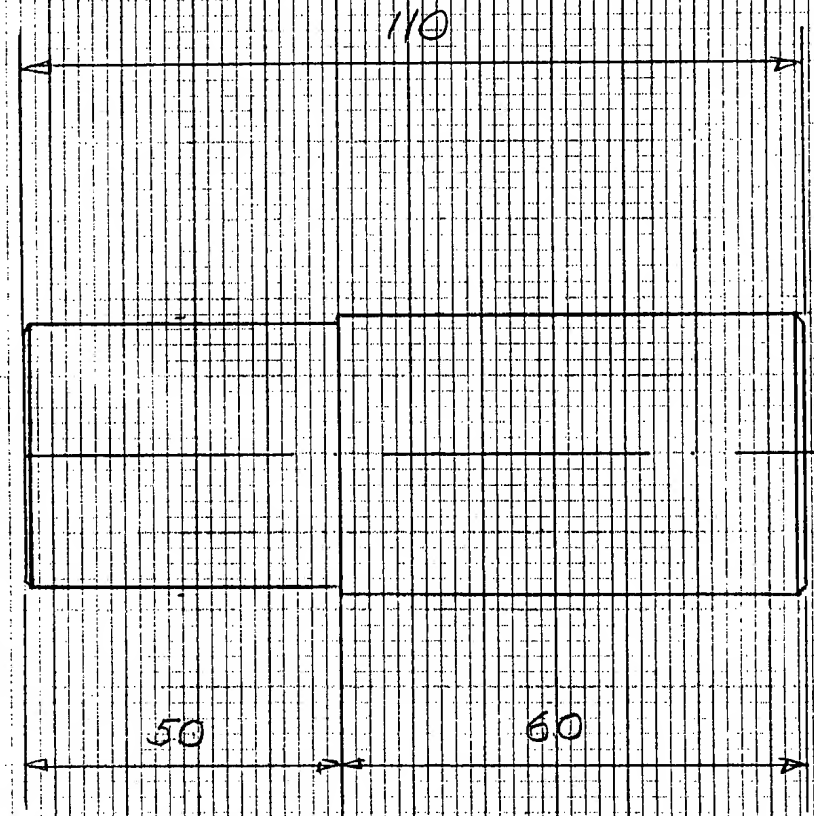
B/W SOLAR
9 Newborough Street
Scarborough W.A. 6019
Phone-Fax: (08) 9341 8711

Stuffing Box 1:1 PVC Rod 60,65 L



B/W SOLAR
9 Newborough Street,
Scarborough W.A. 6019
Phone-Fax (09) 341 8711

Steel

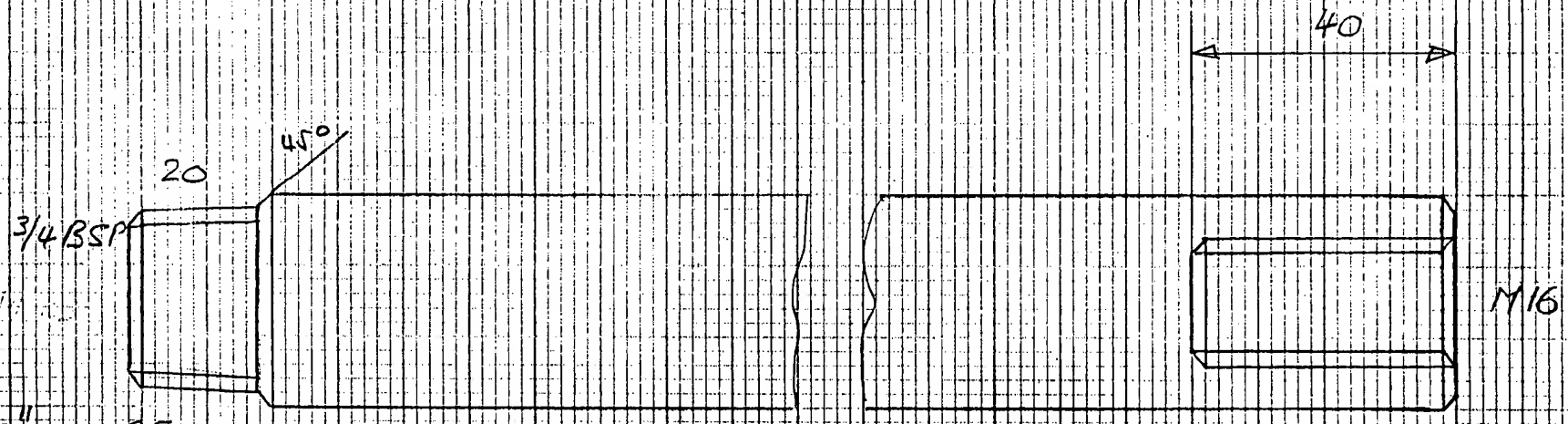


B/W SOLAR
9 Newborough Street,
Scarborough W.A. 6019
Phone-Fax (09) 341 8711

10.10.95

ϕ 560

PUMP-RODS. ϕ 30 0,5 m + 0,625 m LONG



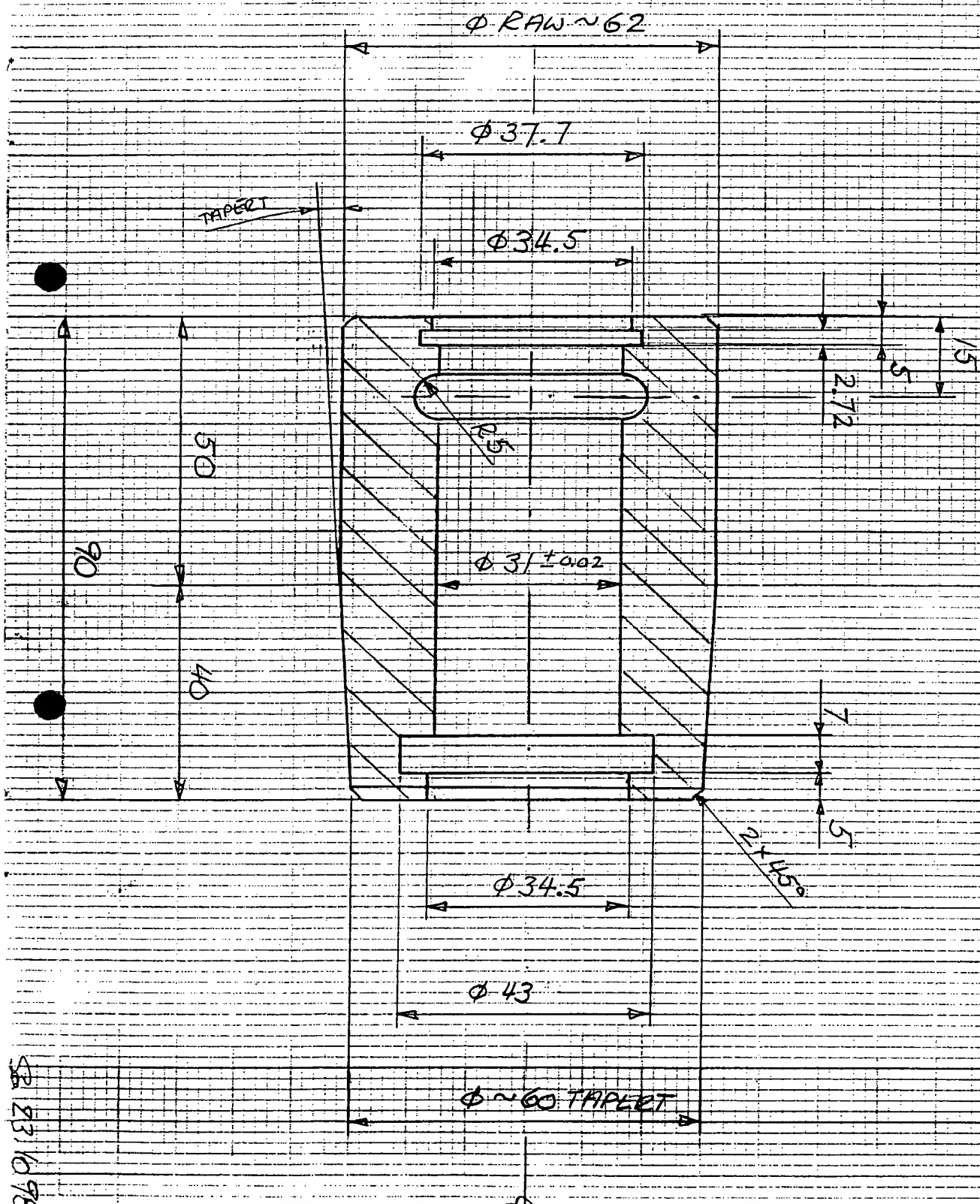
B/W SOLAR
9 Newborough Street
Scarborough W.A. 6019
Phone-Fax (09) 341-8711

9108

STUFFING BOX 1:1

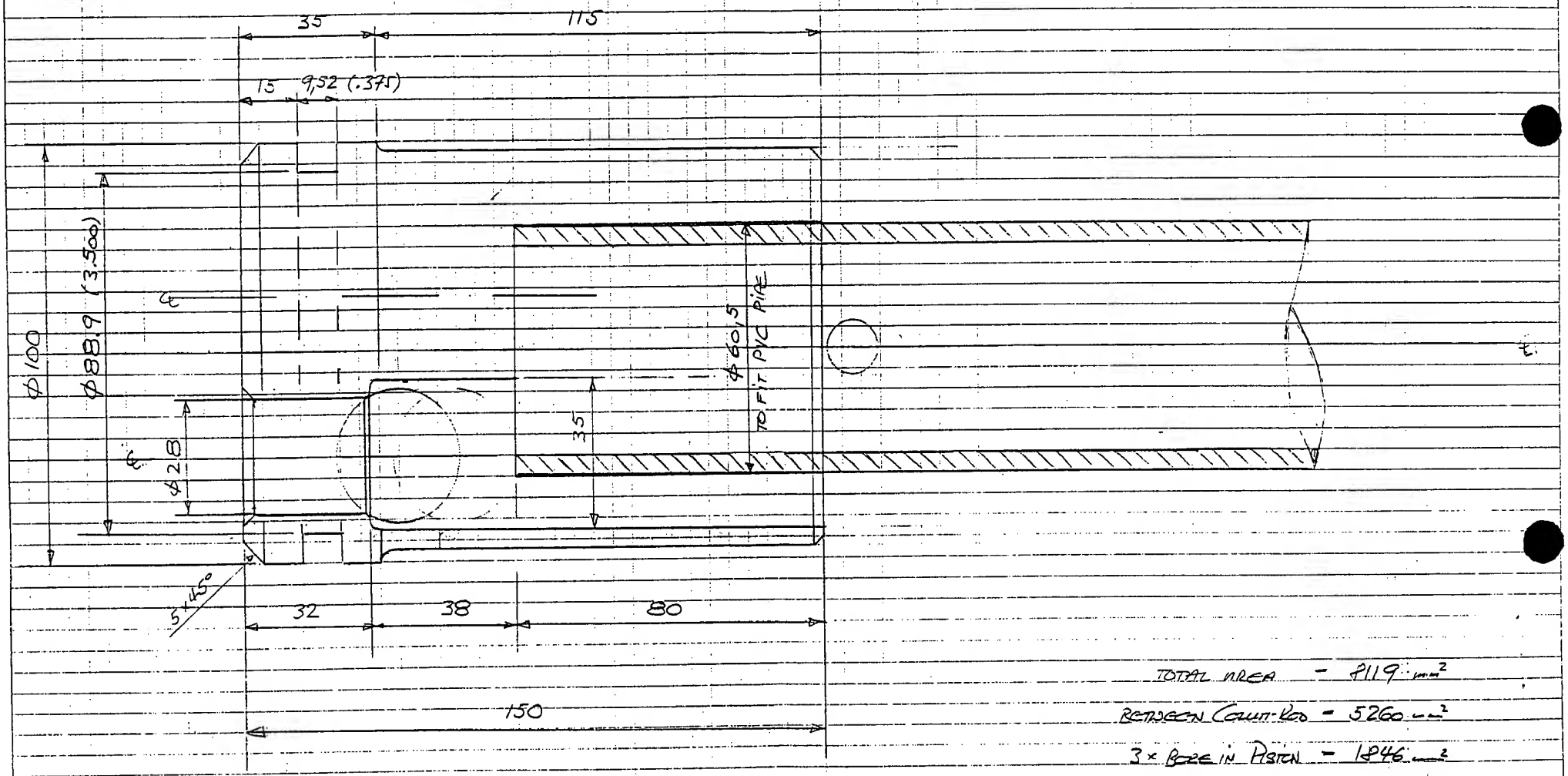
PVC Ø 60

Ø ROH = 30.8



5mm squares

PISTON 1:1 PVC 100 CYLINDER BORE 101,7mm Ø



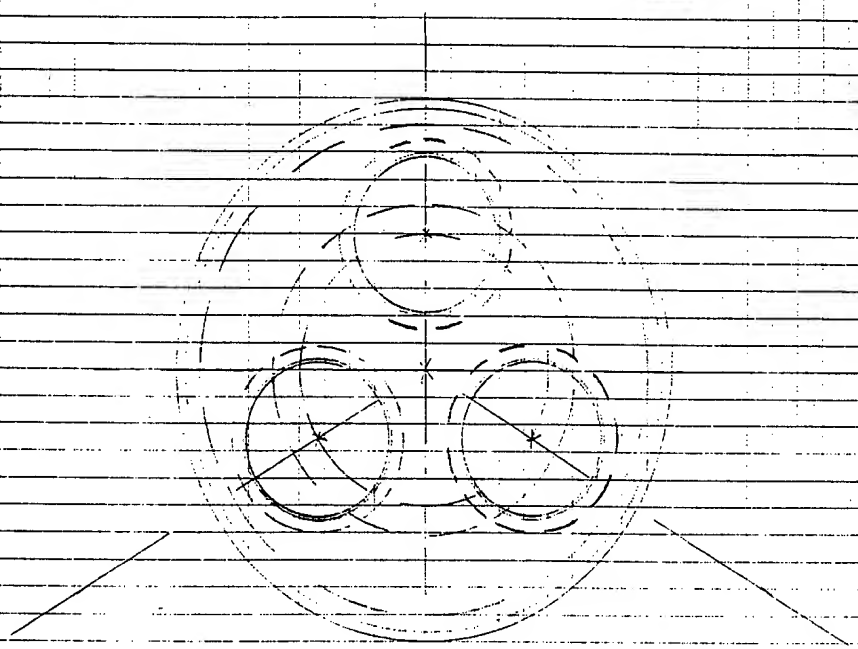
TOTAL AREA - 8119 mm²

BETWEEN CONN-ROD - 5260 mm²

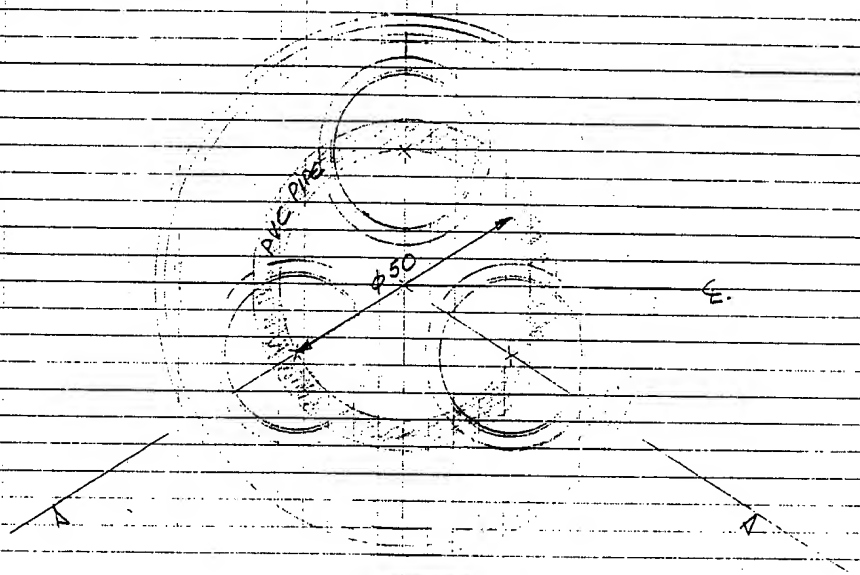
3 × BORE IN PISTON - 1846 mm²

B/W SOLAR
9 Newborough Street
Scarborough W.A. 6
Phone-Fax (09) 341
14.

PISTON 1:1 PVC 100



FROM THE TOP



B/W SOLAR
9 Newborough Street,
Scarborough W.A. 6019
Phone-Fax (09) 341 8711

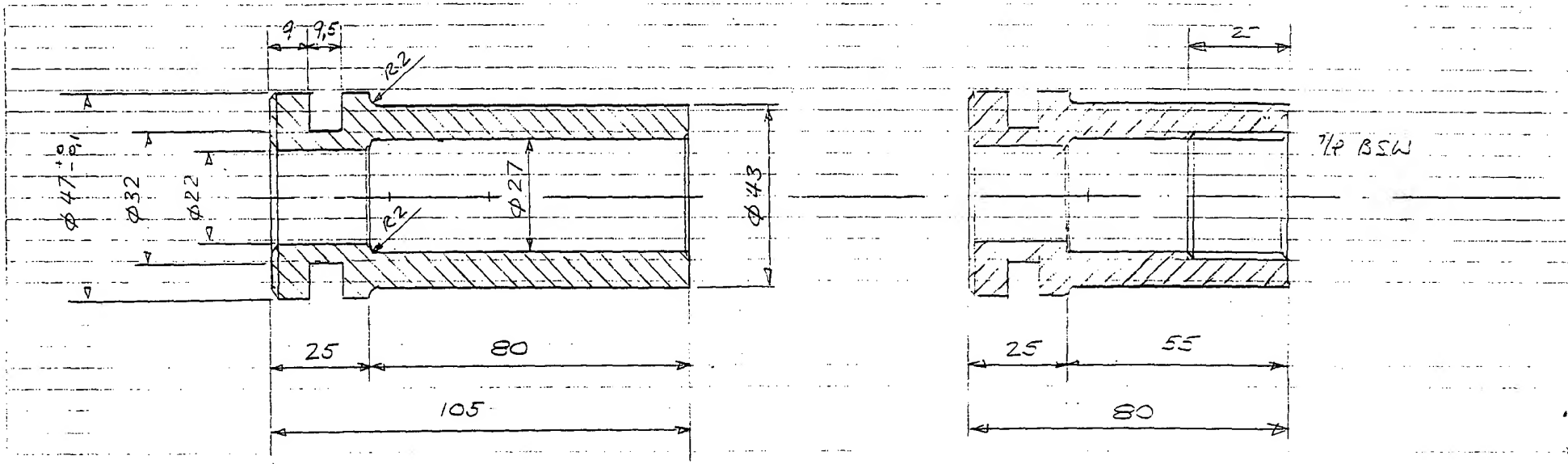
14 10 97

5mm squares

PISTON 1:1 PVC Ø50 see LU 25

10.-

DE 187/25



BETWEEN PISTON + COUNTER = 450 cm³

BORE IN PISTON 5 CC = 320 cm³

3 x 1/2" HOLES = 386 cm³

3 HOLES 37 APART / 32mm UP

B/W SOLAR
9 Newborough Street
Scarborough W.A. 6019
Phone-Fax: (08) 9341 8711

23.798 PW

B/W SOLAR
9 Newborough Street.
Scarborough W.A. 6019
Phone-Fax (09) 341 87

23.10.98